MOBILE EXPERTS

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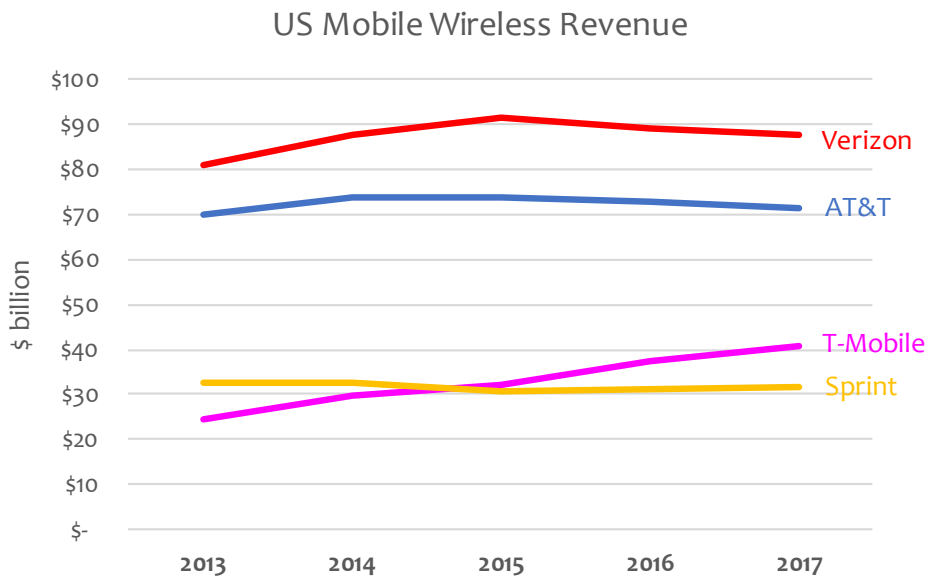
5G Investment Outlook Post-T-Mobile/Sprint Merger

Introduction: US Wireless Market Competition and Industry Structure

The US mobile wireless industry remains dynamic with T-Mobile's resurgence with its "Un-carrier" strategy taking share from the competition. While the overall industry continues to grow its top-line revenue from handset sales, the service revenue has actually declined slightly over the past several years from about $179 billion in 2013 to less than $174 billion in 2017 as result of competitive pricing pressures.



Source: Mobile Experts

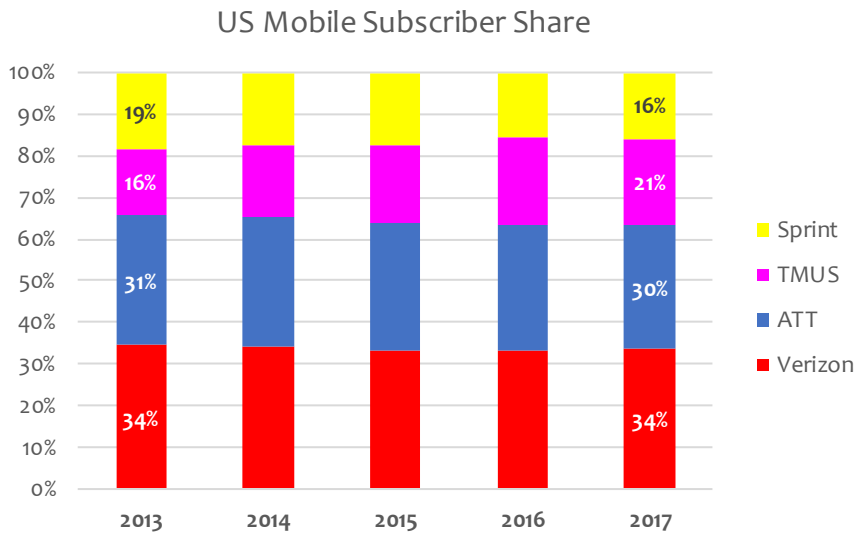
Figure 1. The US wireless industry is competitive and dynamic

Despite a dozen or so "Un-carrier" moves from T-Mobile and similar moves from others, the overall industry structure hasn't really changed that much in terms of mobile connections. While T-Mobile has certainly grown its subscriber base meaningfully, the overall industry structure remains largely intact in terms of market share especially among high-value postpaid subscribers. The market remains a duopoly (i.e., Verizon and AT&T) with two challengers (i.e., T-Mobile and Sprint) vying for market share gains in a saturated mobile broadband market. This "duopoly plus challenger" structure is even more startling in terms of free cash flow, which ultimately measures financial performance and "health" of a company. In 2017, for example, Verizon reported over $8 billion of free cash flow[1] while T-Mobile and Sprint reported just $2.7 billion and $790 million respectively.

Being a sub-scale player in the capital-intensive wireless industry is tough as there aren't enough profit dollars left to fund capital expenditures needed to compete. While T-Mobile has certainly

[1] Verizon's free cash flow reflects the company's combined Wireless and Wireline businesses, i.e., $25B net cash from operating activities, less $17B in capital expenditure. It should be noted that Verizon's Wireless capital expenditure was just over $8.1B.

improved its position, Sprint remains challenged with the near-term prospect of increased capital expenditure to compete in the "5G era". Sprint must invest, but their capex is not necessarily offset by a firm outlook of new subscriber net-adds.



Source: Mobile Experts

Figure 2. Still, the US wireless industry structure largely remains the same

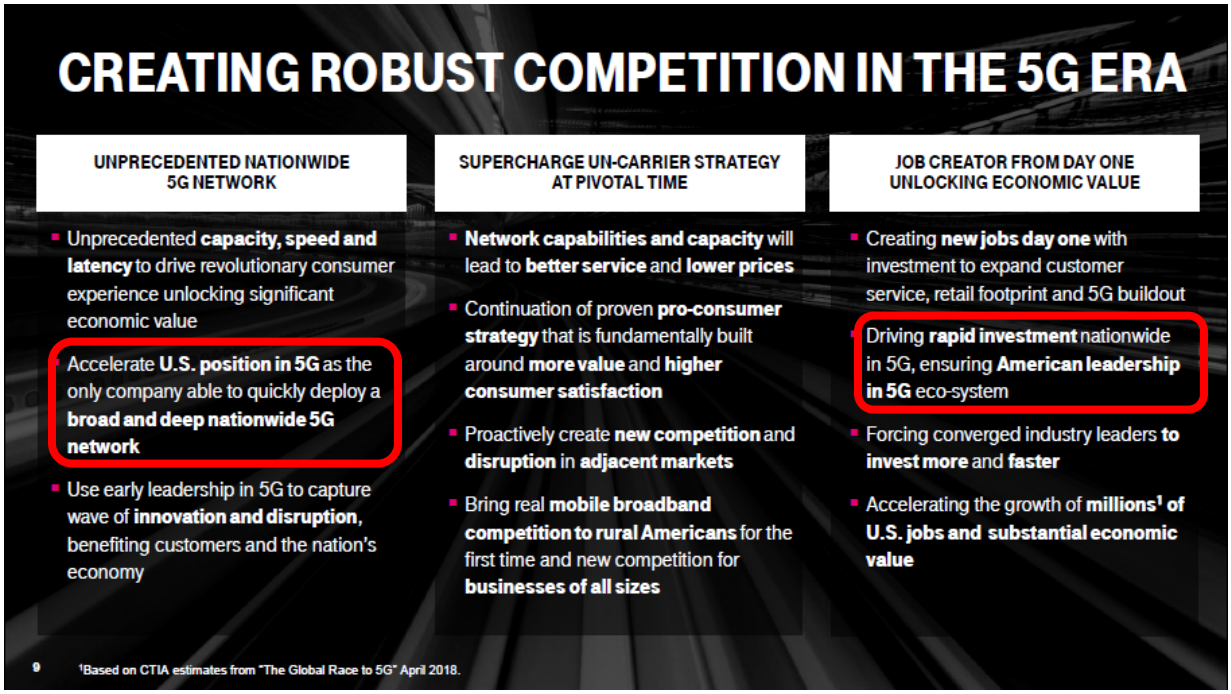
Based on the market share shift as shown above, T-Mobile's gains appear to be largely from Sprint's loss. Another trend that may have helped T-Mobile's recent success is the transition of prepaid to postpaid accounts. The competitive pricing on postpaid plans has likely expedited this transition. While T-Mobile has arguably captured some subscribers away from Verizon and AT&T as well, we believe the leading players have largely kept their core customers. As the market transitions to 5G and a pool of "unhappy" Sprint customers and prepaid customers gets smaller, it is debatable whether T-Mobile will be able to maintain its steady gains beyond what it has achieved thus far.

T-Mobile/Sprint Merger ("NewCo") – A Better Competitor in the 5G Era?

As the US mobile industry transitions from 4G to 5G, one wonders what's next? Can all operators keep up the pace of network investments as the market transitions to the next technology evolution and the new applications and opportunities that they promise, such as industrial IoT and ultra-mobile broadband? Against this backdrop, T-Mobile (#3 player) and Sprint (#4 player) announced their merger plan about a month ago -- after several earlier attempts in recent years. One rationale for the proposed merger is that the "NewCo" (the combined T-Mobile and Sprint company which will be branded as T-Mobile[2]) will be a robust competitor in the 5G era and that the NewCo will "accelerate US position in 5G" and "drive rapid investment nationwide." Will this

[2] With T-Mobile executives and brand taking leading roles, the merger is surely not of equals. T-Mobile is taking over Sprint.

be true? Will the combined NewCo accelerate 5G investments in the US? Is the US market better off as a three-player market with the combination of T-Mobile and Sprint vs. a four-player market with T-Mobile and Sprint as standalone entities?



Source: T-Mobile Sprint merger presentation

Figure 3. T-Mobile proposes rapid 5G investment post Sprint merger

In this paper, we explore these questions regarding implications of the T-Mobile and Sprint merger on 5G investments in the US. While the ultimate decision to approve or deny this merger by the government regulators will involve multi-faceted aspects ranging from market competition to political factors, our assessment focuses on market trends and technology development.

T-Mobile's Network and 5G Plan

T-Mobile has made great strides in its network buildout since its failed merger with AT&T in late 2011. The company has made a remarkable turnaround since the days of being the fourth major mobile operator in late 2000's when it lost lucrative contract customers to AT&T and Verizon who were enticing consumers with premium iPhones and Android devices. Making huge network investments for LTE seem a far-fetched idea at the time when it was losing customers in droves. While the parent company, Deutsche Telekom, was eager to offload its US arm to AT&T when the overture was made, the Department of Justice essentially blocked the merger when it brought a lawsuit against AT&T and T-Mobile. In hindsight, the failed merger was a blessing in

disguise as it brought valuable low-band spectrum and cash to T-Mobile.[3] The 700 MHz spectrum and the cash infusion from the "break-up" fee allowed T-Mobile to build out broader network coverage.

T-Mobile's LTE network coverage has broadened dramatically from almost none in 2012 to over 320M population coverage in the past five years as seen by company's internal coverage maps.

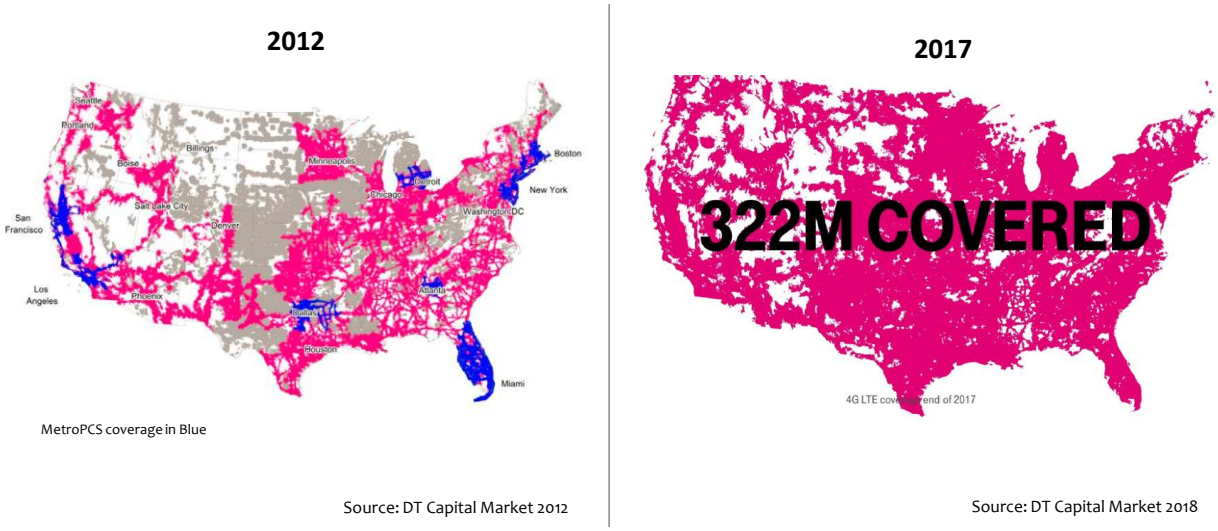


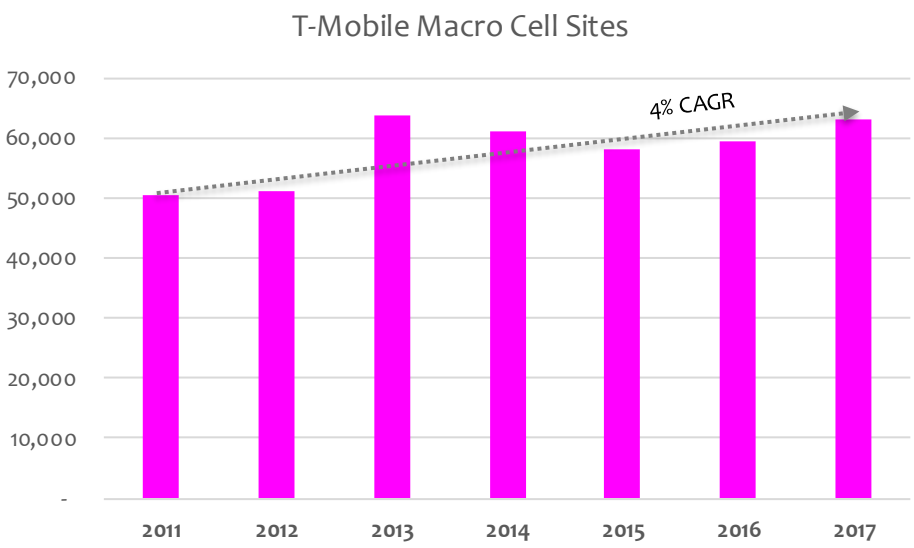
Figure 4. T-Mobile network has expanded rapidly from HSPA to 322M LTE PoP coverage

This rapid LTE network transformation involved macro cell site expansion as well as spectrum re-farming and new spectrum deployment especially the 700 MHz spectrum coverage. Deploying spectrum on macro cell sites (especially the low-band) is generally the most economical means to expand coverage.

T-Mobile's Network Densification

T-Mobile has been prudently expanding its macro cell footprint since 2013, when it started carefully integrating MetroPCS assets. The company continues to optimize its network footprint. As shown below, the company appears to have decommissioned some of its macro cell sites since integrating MetroPCS cell sites. By our estimate, the company has about 63,000 macro cell sites at the end of 2017 which is slightly more than Verizon (~61,000) and less than AT&T (67,000~68,000). In addition to densification at the macro layer, the company plans to roll out 25,000 small cells in 2018 and 2019 to further enhance its network capacity in certain "hotspot" locations in urban areas.

[3] Wall Street Journal (25 Nov 2011) reported that AT&T had set aside $4B ($3B cash and $1B in spectrum) for the "break-up" fee.



Source: FCC, Mobile Experts

Figure 5. T-Mobile has been increasing its Macro footprint to expand LTE coverage

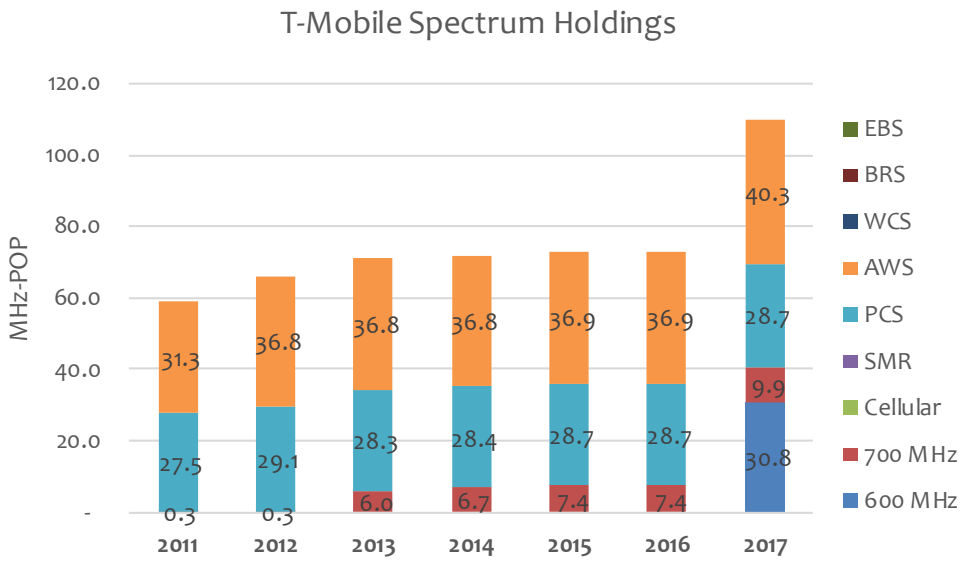
Besides the physical expansion of network infrastructure and cell sites, the company continues to leverage the latest technology advancements to further expand network capacity and increase network speed:

- Voice over LTE (VoLTE) to free up spectrum from legacy 2G and 3G voice services – the company is reporting almost 80% of total voice calls are carried through VoLTE
- 4x4 MIMO to increase data paths to effectively increase capacity and speed – the company is reporting that 4x4 MIMO has been implemented in 475 markets
- Carrier Aggregation (CA) to increase speed performance by bonding multiple channels – the company is reporting CA is available in over 875 markets
- 256 QAM to increase spectral efficiency (i.e., more bits per Hz of spectrum) – the company is reporting that this has been rolled out in over 925 markets
- Licensed Assisted Access (LAA) to leverage unlicensed spectrum for LTE to further increase network capacity and speed – the company is likely to deploy LAA in conjunction with small cell deployment

T-Mobile's Spectrum Growth

In addition to the physical cell site expansion, T-Mobile continues to add low band spectrum to bolster its network coverage depth. The company recently acquired 31 MHz of average nationwide 600 MHz spectrum paying $8 billion. While the initial 700 MHz spectrum deployment

has allowed the company to expand its LTE coverage footprint to over 320M population, the nationwide average of over 30 MHz of 600 MHz spectrum will immediately triple its sub-1GHz spectrum depth. While a full deployment of the entire 600 MHz spectrum will take several years,[4] this low band will provide T-Mobile a runway for "broad and deep" network capacity expansion nationwide. Despite the company's public statements about 600 MHz spectrum use for 5G IoT, we believe T-Mobile's main motivation for the band is to enhance its network capacity for mobile broadband use first and foremost. As the 5G NR ecosystem matures and industrial IoT business cases become clearer, T-Mobile will likely leverage its 600 MHz spectrum and broad and deep network capabilities for those use cases.



Source: FCC, Mobile Experts

Figure 6. T-Mobile has been building up its spectrum holdings especially low-band

It should be noted that T-Mobile's rapid LTE coverage expansion has been primarily driven by the deployment of 700 MHz spectrum. On top of the 700 MHz coverage layer, the company continues to deploy and re-farm mid-band PCS and AWS spectrum. The newly acquired 600 MHz spectrum affords T-Mobile additional avenues to increase network capacity and speed.

While the company has not been a huge proponent of the millimeter wave bands, it has shown renewed interest. T-Mobile recently acquired a big chunk of 28 GHz spectrum license in Ohio and has advocated for millimeter wave band auction across the 24, 28, 37, 39, and 47 GHz bands together.[5] While its near-term focus is squarely on deployment of 600 MHz spectrum it recently acquired, T-Mobile is mindful that the next wave of spectrum strategy is in the millimeter wave

[4] Broadcasters must first clear the 600 MHz spectrum before mobile operators can utilize the band. Some are projecting that this clearing process can take a couple of years out to 2020.

[5] T-Mobile FCC filing regarding a "bundled" auction across multiple millimeter wave bands, April 3, 2018

band to keep up with its competition, Verizon and AT&T which have amassed a significant trove of 28 GHz and 39 GHz spectrum through their recent acquisitions.[6]

T-Mobile's (Standalone) 5G Plan

Prior to the merger announcement, T-Mobile's 5G plan largely centered around 600 MHz spectrum that it actively pursued during the Incentive Auction. While most of 5G press has centered around multi-gigabit speeds and capacity offered through super wideband channels (i.e., hundreds of MHz) available in the millimeter wave bands, T-Mobile is pragmatic in its approach to 5G services. It knows that it needs to broaden and deepen its network coverage and capacity in order to compete effectively against Verizon and AT&T which still tout more expansive geographic coverage. Touting higher network speeds is meaningless if you don't have coverage. T-Mobile's core focus on cell site expansion and deployment of 600 MHz, PCS, and AWS spectrum to deepen network capacity is central to its 4G LTE and 5G strategy. T-Mobile is keen to be on par with Verizon and AT&T on network coverage first and foremost, and 5G is a natural technology evolution to achieve higher mobile broadband capabilities.

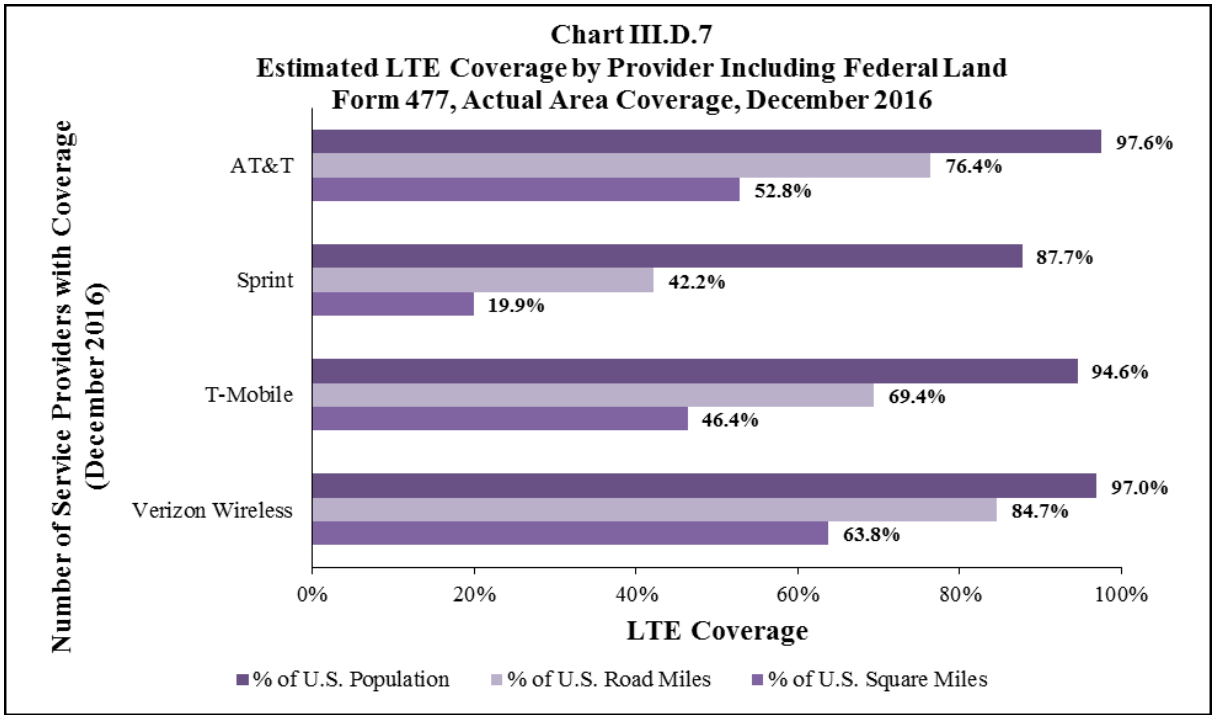
Mobile Experts believes that T-Mobile's 5G messaging centered on the 600MHz nationwide coverage affords T-Mobile to tout its spectrum differentiation, i.e., over 30 MHz of 600 MHz spectrum nationwide. Its 5G story is certainly differentiated against Verizon's fixed wireless access and AT&T's "5G Evolution" narratives. 5G messaging from the various operators are arguably difficult to discern at this early stage of the technology transition. T-Mobile's 5G plan around 600 MHz expansion provides a roadmap to continued network capacity expansion for LTE and eventually to 5G, and allows the company to take advantage of 5G IoT and other unique business opportunities beyond the mobile broadband mainstay. The narrow bandwidth at 600 MHz means that capacity will be limited, so this plan does not take T-Mobile very far—even with 5G, the 600 MHz spectrum will fill up very quickly.

Sprint's Network and 5G Plan

Sprint's LTE network coverage has lagged behind the competition for many years as the company has not sufficiently invested in network infrastructure. Its financial situation has deteriorated in the midst of heightened competitive environment in recent years. According to FCC's most recent report[7], Sprint's LTE network coverage lags behind the competition by significant margins in both population and geographic coverage basis. It lags Verizon by almost 10% in terms of population coverage (i.e., ~88% vs. 97%) and by over 40% in terms of geographic coverage (i.e., ~20% vs ~64%)! Despite its claims of network speed advantages in certain cities, not having a sufficiently broad network puts Sprint at a disadvantage especially when the

[6] Verizon has acquired significant millimeter wave band spectrum through its XO and Straightpath acquisition. Meanwhile, AT&T acquired 39 GHz spectrum through its FiberTower acquisition.
[7] FCC 20th Wireless Competition report (published Sep. 2017)

network coverage differences with the competition are so stark.[8] While Sprint has improved its LTE network coverage in recent years, the pace of improvement is nowhere near that of T-Mobile. For instance, according to FCC, Sprint's LTE network population coverage was ahead of T-Mobile at the end of 2014 (i.e., ~85% vs. ~82%). In just two years, T-Mobile has pulled ahead of Sprint by ~95% vs. ~88%. In other words, T-Mobile has improved its LTE coverage by almost 13% in two years while Sprint has only improved its coverage by 3% during that period.



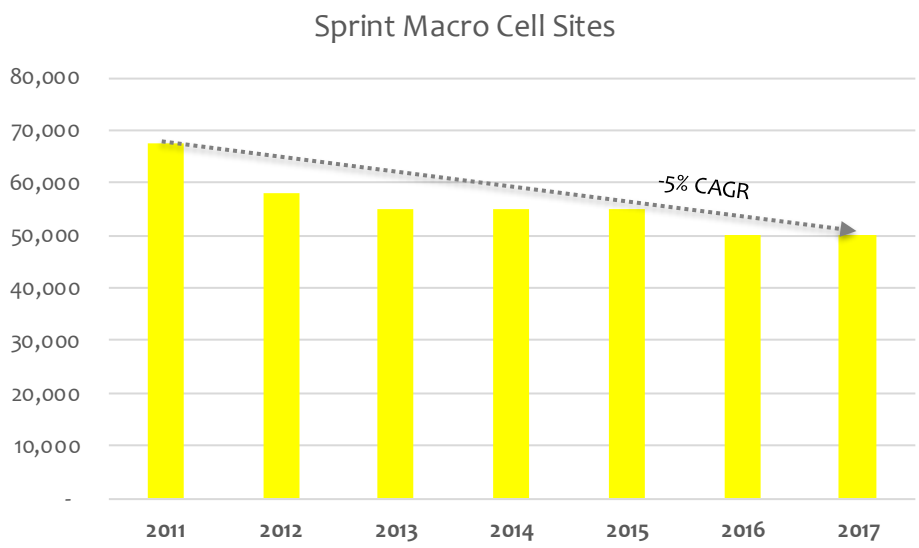
Source: FCC 20th Wireless Competition report

Figure 7. Sprint's LTE network coverage continues to lag behind competition

Sprint's Stagnant Network Investment Finally Ramping Up?

While T-Mobile leveraged the breakup proceeds from the failed merger with AT&T to invest in its network expansion, Sprint has been struggling since the Nextel merger and costly integration. The company has been reducing its macro cell sites to reduce operational expenses. With deteriorating finances, instead of expanding network footprint, Sprint has, in fact, been divesting physical infrastructure footprint to reduce operational expenses. Sprint's macro cell sites has gone from the height of over 67,000 macro cell sites in 2011 to estimated 50,000 today.

[8] Smaller network footprint translates to higher operation expenses due to roaming fees often paid to competition. "Owner" economics is crucial in mobile industry which is all about scale.



Source: FCC, Mobile Experts

Figure 8. Sprint has been reducing its Macro footprint for OPEX savings

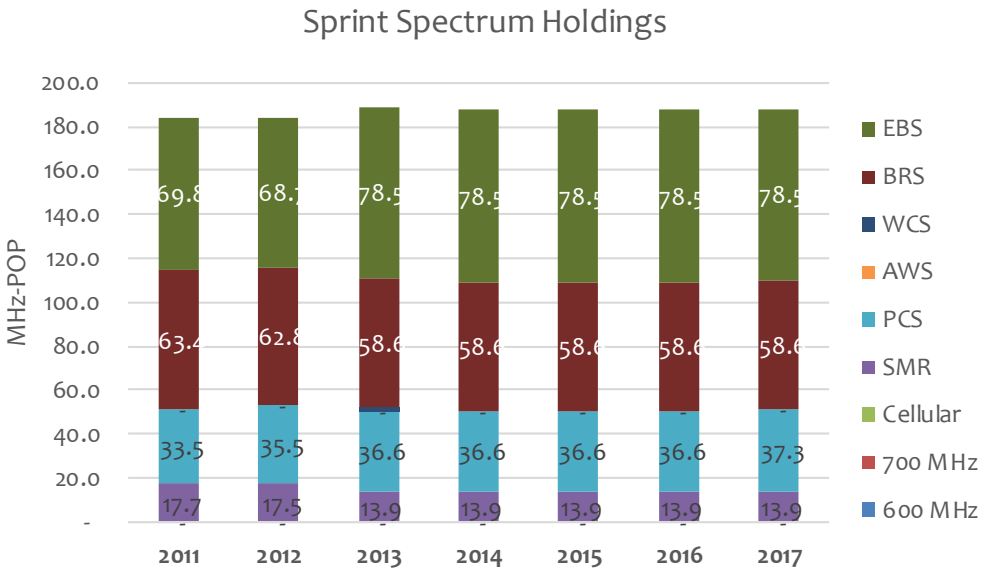
While the company has stabilized its finances and network performance under Softbank's ownership, the road ahead remains daunting. Under the latest network expansion plan, Sprint is upgrading its macro sites to deploy all three bands that it holds including 800 MHz (SMR), 1.9 GHz (PCS), and 2.5 GHz (BRS/EBS) spectrum. Along with selective macro "tri-band" upgrades, Sprint is deploying small cells to fill and/or augment network coverage and capacity. Magic Box is being used as retention tool in both residential and business settings to fill-in network coverage holes and increase network capacity in high-traffic "hotspots." With a significant jump in capital expenditure in 2018, doubling to $5.2 to $6.0 billion from the prior year, Sprint appears to be finally putting its abundant 2.5 GHz spectrum to use.

Sprint's recent surge in investment does not appear to be a fully effective long-term strategy because they'll need far bigger investment in 5G to become competitive. But if Sprint does not invest heavily in 2018, the value of their assets will decline. Their 2018 surge can be considered to be a defensive move to protect the valuation of the company.

Sprint's Abundant Spectrum Holdings in the Mid Band

A lack of spectrum has not been a problem for Sprint for many years. It is the lack of capital and ecosystem partners who are willing to invest in "off-mainstream" spectrum like 800 MHz (SMR) and 2.5 GHz (BRS/EBS) bands which are specific to a single operator. For ecosystem vendor partners to make the necessary R&D investments, a payout has to be worthwhile which often favors popular band plans used by multiple operators like AWS, PCS, and 700 MHz. Again, scale matters in this business!

With the Clearwire buyout in 2013, Sprint holds more than 160 MHz of 2.5 GHz spectrum in the top 100 markets. Until recently, it primarily relied on 800 MHz and 1.9 GHz spectrum for LTE services. A portion of 1.9 GHz spectrum is also used for CDMA voice services as VoLTE becomes more widely adopted among Sprint customers. Under the company's "tri-band" macro upgrades, only about 60 MHz of 2.5 GHz spectrum are being deployed for LTE with three carrier aggregation. With 5G and massive MIMO, Sprint's deep spectrum holdings in 2.5 GHz spectrum are likely to make an impact when (100 MHz) wideband channels can be deployed for higher speeds and capacity.



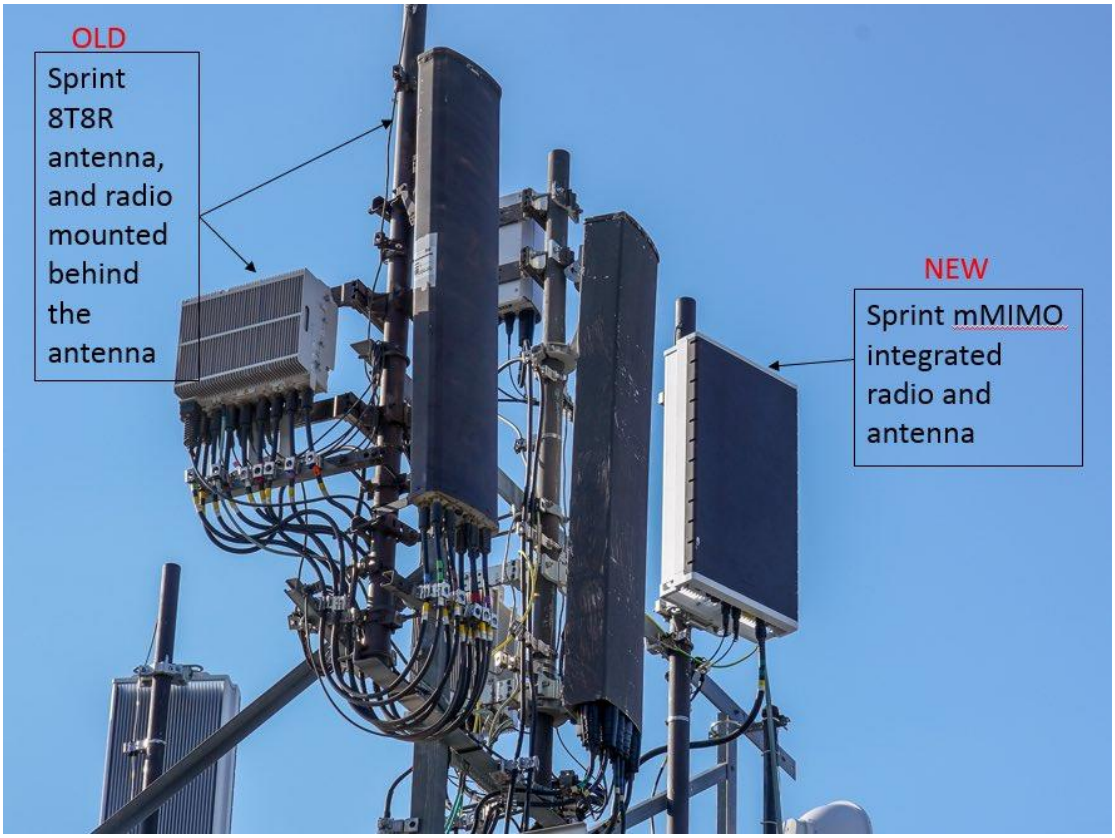
Source: FCC, Mobile Experts

Note: Clearwire's 2.5 GHz (EBS/BRS) spectrum shown under Sprint even though the buyout wasn't completed until 2013

Figure 9. Sprint's rich spectrum positioning hasn't changed much

Sprint's (Standalone) 5G Plan

Sprint's 5G strategy is, unsurprisingly, centered around 2.5 GHz spectrum and the use of massive MIMO. As a part of its so-called "Next-Gen Network" strategy, Sprint plans to add more macro sites and upgrade sites to deploy a full suite of spectrum portfolio including 800 MHz, 1.9 GHz, and 2.5 GHz. With more than 160 MHz of 2.5 GHz spectrum in the top 100 markets, Sprint is planning to deploy 64T64R massive MIMO to take advantage of its unique mid-band spectrum advantage. While the massive MIMO radios will be upgradeable to 5G NR, the initial 2.5 GHz spectrum deployment will use 60 MHz of 2.5 GHz spectrum for LTE, and possibly 100 MHz or more for 5G. When 5G smartphone devices come to market in 2019, the company is expected to simultaneously operate LTE and 5G on multimode radios which have already been deployed.



Source: John Saw twitter post

Figure 10. Sprint Macro Site with 8T8R and Massive MIMO Radios

In addition to the new and upgraded "tri-band" macro sites (as shown above), small cells will be deployed extensively to further densify its network. A portfolio of outdoor small cells on poles and strand-mount will dot its "5G-ready" deployments in 9 cities.[9]

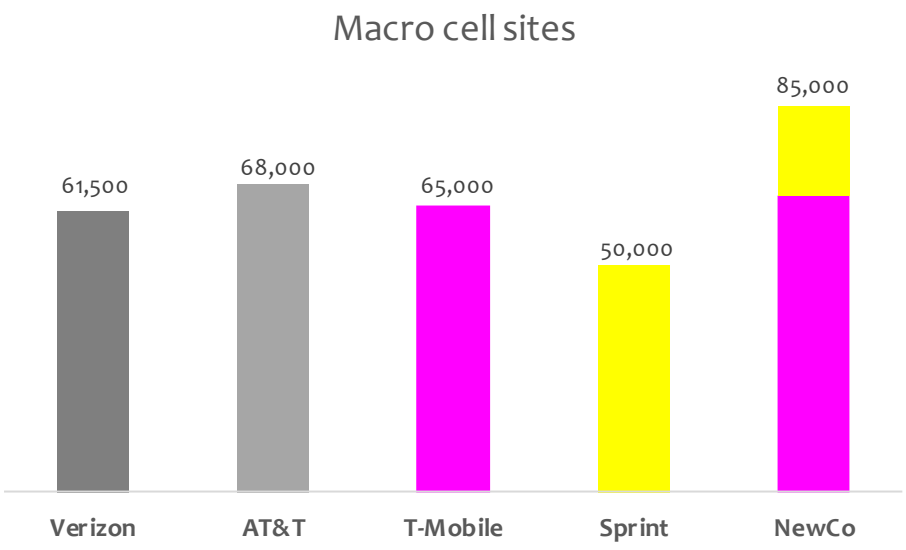
"NewCo" Network and 5G plan

The New T-Mobile's (NewCo) network will be largely based on T-Mobile's existing network as a baseline, and the company will incorporate selected macro sites from Sprint. This minimal integration approach is the same "playbook" that T-Mobile successfully used in the MetroPCS integration.

[9] Along with the initial six cities for "5G ready" cities including Atlanta, Dallas, Houston, L.A., and Washington, DC, Sprint named NYC, Kansas City, and Phoenix to the list of cities where 5G will be launched in early 2019.

T-Mobile Anchor plus Sprint "Keep" Sites

According to the T-Mobile/Sprint joint announcement, the New T-Mobile network will be comprised of 85,000 macro sites and 50,000 small cells. We estimate that NewCo will keep most of T-Mobile's current 63,000-65,000 sites and add about 20,000 Sprint "keep" sites to further increase network density and coverage. It is likely that Sprint's "5G-ready" sites with 2.5 GHz massive MIMO upgrades will be kept along with a bulk of Sprint's outdoor small cells. While the initial 85,000 macro sites touted in the joint merger announcement is reasonable initial figure, we expect this figure to decrease over time as NewCo optimizes its network. Maintaining relatively high number of macro cell sites will be expensive to maintain, and it is much higher than the current configuration.

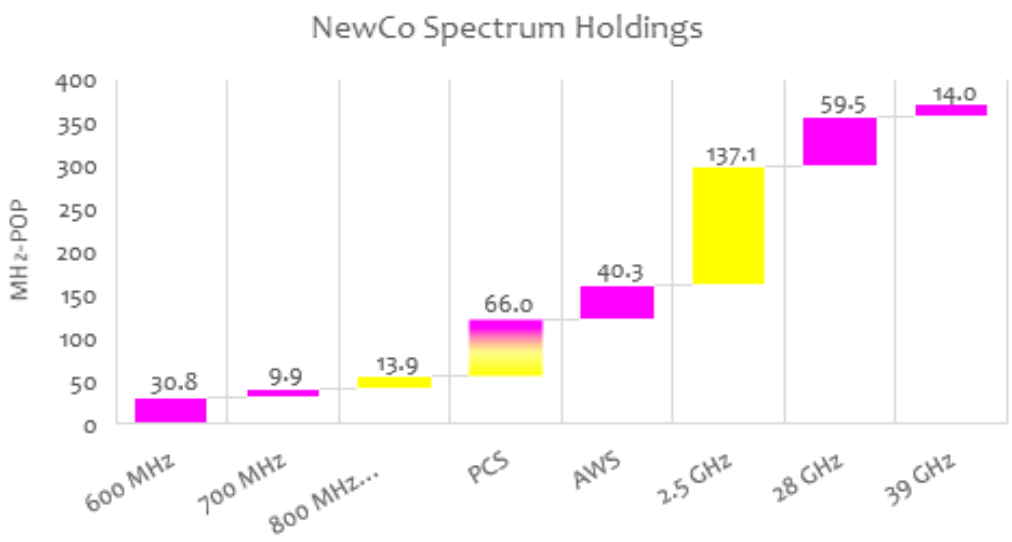


Source: FCC, T-Mobile

Figure 11. T-Mobile "anchor" sites plus Sprint "keep" sites will constitute NewCo network

Robust Low and Mid Spectrum Holdings

Combining T-Mobile's low-band spectrum in 600 MHz and 700 MHz with Sprint's mid-band spectrum in 2.5 GHz will provide a strong foundation for NewCo. The combined spectrum assets will enable NewCo to deploy broad and deep nationwide network. The combined spectrum assets would include a nationwide average of more than 50 MHz-POP of low-band (sub 1 GHz), 240 MHz-PoP of mid-band, and 70 MHz-PoP of millimeter wave band spectrum.



Source: FCC, Mobile Experts

Notes: T-Mobile's spectrum in PINK and Sprint's spectrum in YELLOW. PCS spectrum contributions from both.

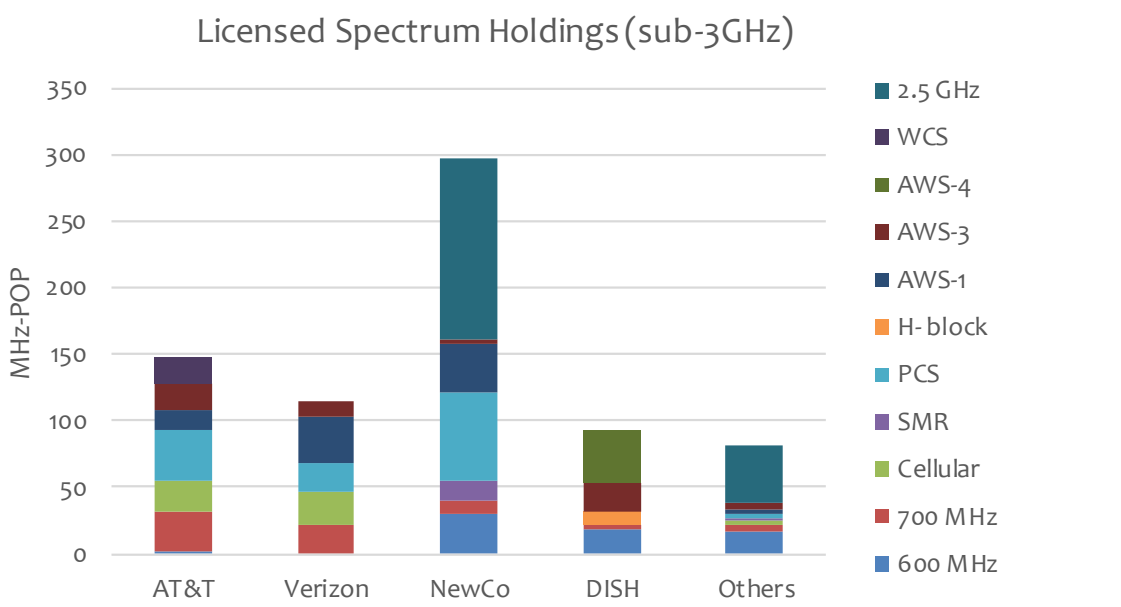
Figure 12. NewCo will have over 370 MHz-POP of licensed spectrum[10]

For the top 100 markets, the combined NewCo actually has more than 160 MHz of 2.5 GHz spectrum. It is feasible for the company to dedicate the wide channels of more than 100 MHz while delivering coverage characteristics of the mid-band. We believe the initial 2.5 GHz spectrum deployment will employ 60 MHz for LTE and perhaps deploy over 100 MHz as 5G NR equipment become available in the next couple of years.[11]

Almost 300 MHz-POP of low and mid-band spectrum assets will put NewCo ahead of AT&T and Verizon at this stage.

[10] Assuming that the NewCo retains all of the combined T-Mobile and Sprint licensed spectrum. The NewCo may be required to divest some of its spectrum holdings as a part of merger "remedies."

[11] Sprint CEO at a recent investor conference in May 2018 stated that 60 MHz of 2.5 GHz spectrum will be deployed for LTE and the rest of about 100 MHz of 2.5 GHz spectrum for 5G. It should be noted that Sprint holds about 160 MHz of 2.5 GHz spectrum in the top 100 markets.



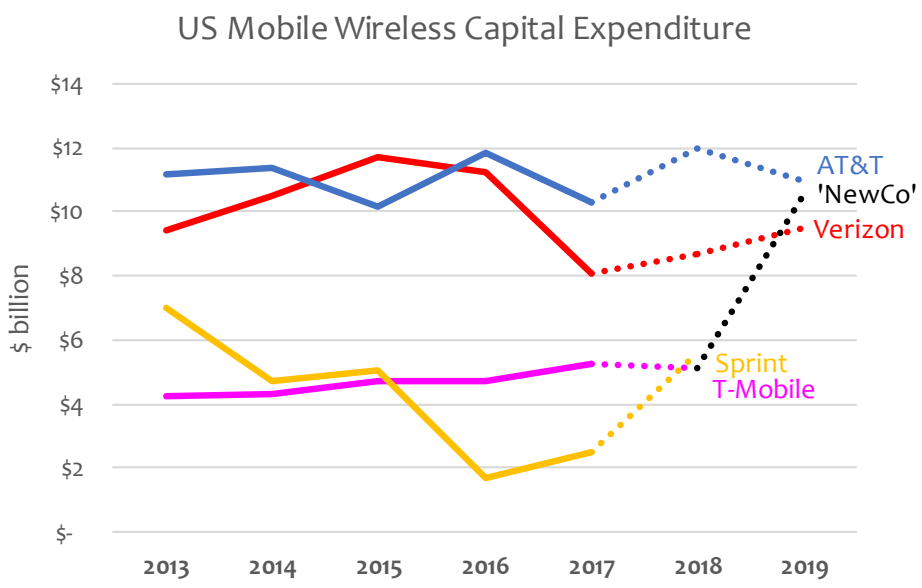
Source: FCC, Mobile Experts

Figure 13. NewCo would hold a sizable sub-3GHz spectrum advantage

5G Investment (Pre- vs. Post-Merger) – Will It Increase?

As the industry transitions to 5G, all players recognize that they need to invest in order to compete. It's really a matter of how much they can and willing to spend. For Verizon and AT&T, they have the scale and financial free cash flow to invest in their networks. T-Mobile has largely achieved the scale and financial performance to invest in its network (albeit at about half of what AT&T and Verizon spends annually). For Sprint, the situation is dire as it must invest in its network to compete, but it doesn't generate enough cash from operations to maintain the level of investment that it needs. Sprint has been borrowing, but debt financing can't last forever.

In the near term, all players recognize that they need to invest in networks (especially Sprint). Based on different network strategy and growth plans, we expect AT&T and Verizon to expand their capital expenditure this year. AT&T is expected to increase its capital expenditure as a part of its FirstNet commitment and "5G Evolution" roll out, and Verizon will further densify its network. It should be noted that these capital expenditure increases are not dramatically different than the past trends. The top players have been spending $8-10Bin capital expenditure on their wireless businesses. While Sprint has really stepped up this year to increase capital expenditure to around $5-6B range, this again is not dramatically different than the historical trends. As a combined company, T-Mobile and Sprint is expected to spend about $10-11B in 2018. At this level, the combined company (NewCo) would be in the same league as AT&T and Verizon in terms of capital expenditure.



Source: Mobile Experts

Notes:
1) Verizon capital expenditure estimate based on similar past trend ($17-17.8 B total CapEx guidance in 2018)
2) AT&T capital expenditure guidance in 2018 is up to $25B total; forecast return to past trend in 2019
3) Sprint is guiding towards $5.2-$6.0 B capital expenditure in 2018 (CEO comment at JP Morgan conference)
4) T-Mobile is guiding towards $4.9-$5.3 B capital expenditure in 2018
5) NewCo proforma of $10-11 B capital expenditure in 2018 (T-Mobile/Sprint merger investor presentation)

Figure 14. US Mobile Wireless Capital Expenditure Outlook

So, would 5G investment go up as result of the merger? While it is difficult to separate 5G investment from the general network capital expenditure, we estimate that Sprint's ability to continue its level of network investment is highly speculative beyond the next couple of years and depends on multiple scenarios that may play out. Sprint's current network strategy around 2.5 GHz spectrum deployment using massive MIMO will likely pan out over 2018-2019 while it awaits the merger outcome. Assuming that its network buildout is successful and the company is able to improve its financial situation as a result, it may be able to maintain its current capital expenditure trend at around $5B. If it's not able to improve its business attracting new customers, it may need to fall back to "belt-tightening" trend of spending much less. In the meantime, T-Mobile's outlook as a standalone company looks much brighter. Assuming business as usual, we estimate T-Mobile's capital expenditure outlook to steadily increase over time.

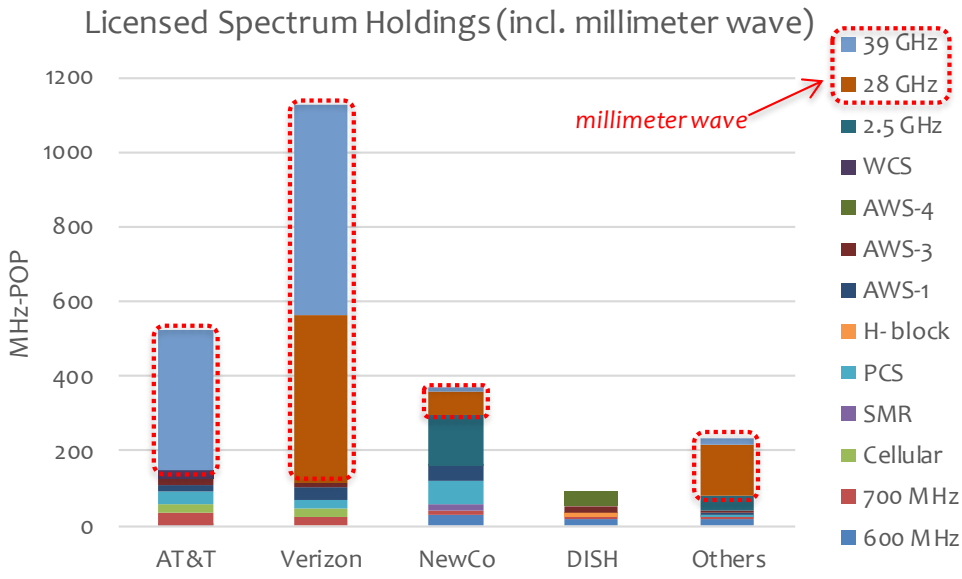
Based on the above assumptions and market outlook, we believe a general network investment outlook is firmer with the combined entity of T-Mobile and Sprint rather than as standalone companies. The difference between pre- vs. post-merger investment outlook is not that significant in total dollars….but the investments of the two companies would overlap in the same locations, so in fact NewCo investment would be much more impactful than the same dollars invested separately.

Table 1. Pre- vs. Post-Merger Capital Expenditure Estimate

($ in billions)	2018	2019	2020	2021	2022
T-Mobile	$4.9 - 5.3	~ $5.4	~$5.7	~$6.0	~$6.3
Sprint	$5.2 - 6.0	~$5.0	~$3.0	~$2.0	~$1.0
NewCo	$10 - 11	~$11.8	~$11.2	~$10.2	~$9.2

Notes: 1) T-Mobile standalone estimate based on past trend of 5% CAGR growth in capital expenditure spend
2) Sprint capital expenditure estimate is highly speculative as its financial situation may not allow it to expand CAPEX
3) NewCo capital expenditure estimate based on 15-20% of service revenue spend on capital expenditure target in the next 3-4 years

As we look out into the next wave of spectrum acquisitions in the millimeter wave bands and eventual network deployment to put those spectrum to use, we believe that a smaller number of stronger competitors is better than numerous weaker players. Continual network investment is a critical aspect of the mobile industry, and the industry demands scale to compete and thrive.



Source: FCC, T-Mobile FCC filing (April 2018)

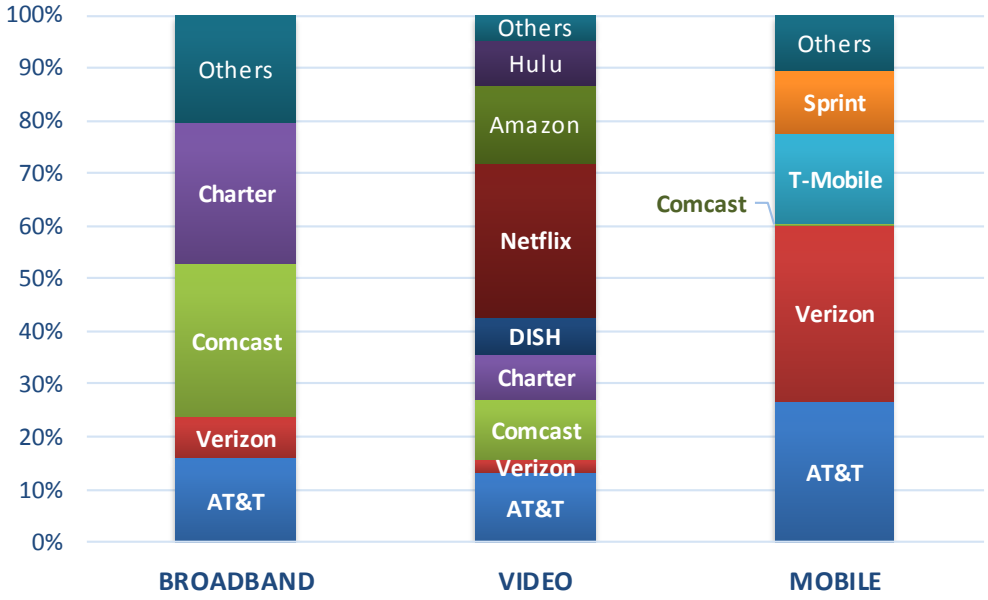
Figure 15. US operators have begun spectrum acquisition in the millimeter wave bands

Three or Five Player Market?

Opponents of the merger cite that reducing the number of operators is bad for consumers as it would reduce competition and bring higher prices. The executives at T-Mobile and Sprint contend that the wireless market is changing and that there are new competitors like Comcast, Charter, and perhaps even DISH, at some point down the road, coming into the market. So, who is right? Will the proposed merger hamper competition and bring higher prices to consumers? The answer depends on how one views the market dynamics. Is the US mobile wireless industry a "siloed" telecommunications market segment without competitive threat or response from adjacent market players? For example, will fixed broadband players such as cable operators fiercely compete for mobile wireless subscribers? In other words, will fixed and wireless players maintain their bounded competitive stance for long?

Fixed-Mobile Convergence and Evolving Competition

Historically, the fixed, mobile, and video markets have been distinctively separate markets. Incumbent telcos provided fixed broadband services; and cable and satellite players provided video or PayTV services; and, cellular players provided mobile services. As the technology evolved and consumer appetite for connectivity services grew, the markets began to overlap. Cable players began to offer superior fixed broadband services with DOCSIS on hybrid fiber coax plant. Meanwhile, many traditional telcos embarked on wireless businesses.



Source: Mobile Experts

Notes: 1) Broadband and Video connections are per household (possibly per individual in Video OTT case);
2) Mobile connections are per individual subscriber;
3) Video connections reflect facilities-based and OTT (Netflix, Amazon, and Hulu) pay subscriptions

4) Amazon reflects Prime Video 'watchers' out of the estimated 90M Prime members

Figure 16. US Fixed Broadband/Video/Mobile Connections Share (as of 1Q'18)

Today, the fixed broadband market in the US is dominated by cable operators with their dense fiber/coax plant. Unlike the US wireless industry, competitive dynamics in the fixed broadband market have been relatively calm. With non-overlapping franchise footprints, cable operators have been gaining overall fixed broadband market share away from incumbent telcos. Even though telco investments in fiber have increased in recent years, their primary focus is largely centered around enhancing backhaul for their wireless businesses and targeting large enterprise customers.

The US mobile wireless industry continues to be dynamic as the technology transitions about every decade have reshaped the industry with consolidations to weed out the winners and losers. As the mobile broadband reaches a saturation point with over 100% mobile phone penetration in the US, it is becoming increasingly difficult for the remaining players to grow without further investment in networks and deep market segmentation. Among the four major players, nationwide 5G network investment required to "stay in the game" is becoming increasingly difficult proposition for weaker players without no immediate prospect for growth. We believe the 5G technology transition is forcing T-Mobile and Sprint to merge in order to better compete in the next phase of growth, which includes adjacent market segments: fixed home broadband, video, and industrial applications.

Meanwhile, faster broadband services have disrupted the video/pay-TV market. Faster broadband services have allowed the over-the-top (OTT) players like Netflix to offer on-demand video services through streaming. The flexibility and ease at which video content can be consumed has changed the game. While OTT offerings today do not represent whole substitution of traditional video services, over 100 million paid OTT subscribership in the US represents potential threat to video distribution business and fortunes of media companies.

Cable Entry into Mobile

While cable operators have long dabbled in wireless ventures[12], Comcast's recent mobile entry via Verizon MVNO is a notable achievement in that they now have a retail mobile offering that competes against other major brands. While the scope of Comcast's mobile offering is purposefully limited to its wireline footprint, the scope of mobile service offering is nationwide. With Charter's pending mobile service launch, T-Mobile's narrative about additional competitors entering the mobile market appears to be coming true.

[12] SpectrumCo AWS spectrum buy, and eventual sale to Verizon, Pivot joint venture with Sprint, Clearwire strategic investment are some of the past ventures that cable operators have undertaken in mobile wireless.

Mobile Entry into Fixed Broadband

Just as cable operators are gradually encroaching into mobile industry, mobile operators are also contemplating fixed home broadband service through wireless. Verizon's fixed wireless service targeting 3-5 markets this year is arguably Verizon's "tit" (5G fixed wireless home broadband replacement) for Comcast's "tat" (Xfinity Mobile service offering). Mobile operators are emboldened by the prospect of hundreds of MHz of the millimeter wave bands deployed to serve fixed home broadband services. With the merger announcement, T-Mobile is even touting 5G home broadband replacement service which it had derided prior to the merger announcement. With the potential of 2-3 GHz of millimeter wave bands that may come up for auction, along with more than 160 MHz of 2.5 GHz mid-band spectrum, T-Mobile appears confident that it will be awash with spectrum to service both mobile and fixed broadband customers.

Intra-then-Intermodal Consolidation and Competition

As market matures, consolidation naturally follows as companies look for big cost synergies by combining like-kind operations and to gain scale. We have seen this play out in fixed broadband and mobile wireless segments. The cable industry continues to consolidate as regional players get gobbled up by bigger players. Today, the cable industry is dominated by Comcast and Charter which together can provide a coast-to-coast network footprint. While the industry may further consolidate around Altice and Cox as meaningfully sizable operations, the major cable operators are beginning to explore adjacent markets for growth. For the major cable operators, a meaningful adjacent market is the mobile industry. Likewise, the mobile operators see likely competitive response to cable operators' mobile entry as fixed broadband entry via wireless. Once major intra-segment cost synergies have been realized, we believe the major fixed and mobile operators will naturally look to intermodal competition and eventual consolidation as winners and losers become more clear. Of course, this will take decades to play out, but the early signs of intermodal competition between fixed and mobile players are visible.

Conclusions

In a capital-intensive industry like the mobile wireless market, bigger is better. Gaining scale is crucial to one's survival as a consistent network investment is necessary to compete. Ability to invest during technology transitions (e.g., 4G to 5G now) is even more crucial as missing a trend, or being perceived as a laggard, can cost you dearly.[13] The US wireless industry has been a

[13] The lack of access to iPhone in early days of iPhone cost T-Mobile and Sprint dearly with loss of contract subscribers to AT&T and Verizon

duopoly (Verizon and AT&T) with fringe players for a decade or so. The proposed T-Mobile and Sprint merger -- assuming that it is approved by the government officials in Washington, D.C. -- has the potential to bring three national players to compete head-to-head. Instead of finding niche segments to exploit, the combined T-Mobile and Sprint has an opportunity to compete head-on with the top two players. Based on our estimate, the strategy to compete head-on with the two major operators will likely expand the investment horizon of the combined T-Mobile and Sprint (NewCo) on par with Verizon and AT&T.

T-Mobile argues that 5G global leadership is one of the benefits of the combined merger with a presumption that the NewCo will be able to expeditiously invest and deploy 5G networks. AT&T and Verizon may argue that the US 5G leadership will be led by them whether the combined T-Mobile and Sprint would jump into the 5G "race." It is likely however, that the combined NewCo would certainly be better positioned financially and asset-wise to expedite its 5G network plan.

The ultimate question comes down to whether one believes that T-Mobile will maintain its "challenger" mentality and disrupt not just the mobile space, but also the adjacent broadband and video spaces. If so, the aggregate 5G investment will increase as a result of competitive intensity it will bring, not just to Verizon and AT&T, but also Comcast and Charter. The initial market actions around cable entry into wireless and mobile entry into home broadband market via fixed wireless access are early guideposts to the fixed-mobile convergence trend that appears to be slipping into the mind share of the telecom leaders. The combined T-Mobile and Sprint may be become formidable catalyst that accelerates the market transition towards fixed-mobile convergence. This merger could disrupt the monopolies and duopolies that have ruled the media/telecom space for a very long time.